

11/28/01

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Therefore, this

United States Patent

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A handwritten signature in black ink that reads "Bruce Lehman". Below the signature, the text "Commissioner of Patents and Trademarks" is printed in a smaller, sans-serif font.

A handwritten signature in black ink that reads "Melvinia Gary". Below the signature, the word "Attest" is printed in a small, sans-serif font.

United States Patent [19]

Spear et al.

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[45] Date of Patent: Jul. 1, 1997

[54] SWEPT TURBOMACHINERY BLADE

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[51] Int. Cl.⁶ F01D 5/14

[52] U.S. Cl. 416/238; 415/181; 416/242

[58] Field of Search 415/181, 220; 416/238, 242, 243

[56] References Cited

U.S. PATENT DOCUMENTS

1,964,525	6/1934	McMahan	170/159
2,154,313	4/1939	McMahan	230/274
2,915,238	12/1959	Szydłowski	230/134
2,934,259	4/1960	Hausmann	415/181
2,935,246	5/1960	Roy	415/181
3,416,725	12/1968	Bohanon	230/259
3,444,817	5/1969	Caldwell	103/88
3,692,425	9/1972	Erwin	415/181
3,989,406	11/1976	Bliss	415/1
4,012,172	3/1977	Schwaar et al.	416/228
4,358,246	11/1982	Hanson et al.	416/223 R

4,408,957	10/1983	Kurzrock et al.	415/181
4,726,737	2/1988	Weingold et al.	416/223 A
4,737,077	4/1988	Vera	416/242
4,784,575	11/1988	Nelson et al.	416/226
5,112,192	5/1992	Weetman	416/201 A
5,167,489	12/1992	Wadia et al.	415/182.1

FOREIGN PATENT DOCUMENTS

1528965 12/1989 U.S.S.R. 416/242

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[57]

ABSTRACT

A swept turbomachinery blade for use in a cascade of such blades is disclosed. The blade (12) has an airfoil (22) uniquely swept so that an endwall shock (64) of limited radial extent and a passage shock (66) are coincident and a working medium (48) flowing through interblade passages (50) is subjected to a single coincident shock rather than the individual shocks. In one embodiment of the invention the forwardmost extremity of the airfoil defines an inner transition point (40) located at an inner transition radius $r_{t\text{-inner}}$. The sweep angle of the airfoil is nondecreasing with increasing radius from the inner transition radius to an outer transition radius $r_{t\text{-outer}}$, radially inward of the airfoil tip (26), and is nonincreasing with increasing radius between the outer transition radius and the airfoil tip.

3 Claims, 7 Drawing Sheets

